Concluding Survey of Stereotactic Procedures

Reviewing this report, the following seem to be most promising and/or the most frequently used chiefly stereotactic procedures:

(1) Anterior cingulotomy in drug-resistant anxiety and depression and emotionally charged pain.

(2) Subcaudate tractotomy (stereotactic lesion in and/or anterior to the substantia innominata) in drug-resistant depression and anxiety with a depressive element. Combined (1) and (2) in obsession and compulsion.

(3) Anterior capsulotomy in obsessive-compulsive states.

(4) Amygdalotomy in aggressiveness, violence of adults, hyperactivity, destructive behavior of feebleminded children, if necessary, combined with posterior hypothalamotomy.

(5) Hypothalamotomy for sedation of aggressive patients, either following inefficient lesions of the dorsomedial and anterior thalamic nuclei or after amygdalotomy or without lesions of these nuclei. Hypothalamotomy involving chiefly the ventromedial nucleus served as a last resort in sexual perversions, occasionally in severe alcoholism and drug addiction.

(6) Experiences with stereotactic subcortical lesions in emotional and behavioral disorders indicate a multiple representation of the mechanisms upon which emotions depend. Besides connections between the frontal, particularly orbital, cortex and the dorsomedial nuclei, the importance of the Papez circuit, of amygdalo-hypothalamic, fronto-septal-hypothalamic, and intradiencephalic circuits became evident. The unspecific thalamocortical projection system may also participate in the genesis of pathologic deviations of emotions and behavior.

(7) Percutaneous chordotomy in chronic, drug-resistant pain.

(8) Combination of lesions of pain conducting and perceiving systems with dorsomedial thalamotomy for relief of chronic, apparently intractable pain with an emotional component.

(9) Deep temporal electroencephalography and combined amygdalo-fomicotomy and anterior commissurotomy in temporal lobe epilepsy.

(10) The experiences with ventralis anterior thalamotomy in convulsive disorders are not sufficient as yet to permit a definite statement.

(11) Pallidoamygdalotomy or CM lesions in salaam convulsions.

(12) Pallidotomy (chiefly lesion of the pallidum internum) and pallidoansotomy were initially applied in paralysis agitans and parkinsonism, mainly for relief of tremor and rigor, also in some instances of choreatic and athetotic hyperkinesia, hemiballism and torsion spasm. It became replaced
by ventrolateral thalamotomy in Parkinson’s disease, parkinsonism, hyperkineses (athetosis, hemiballism, myoclonia, torsion spasm). The effect of ventrolateral thalamotomy is longer lasting than that of pallidotomy.

In Parkinson’s disease and in parkinsonism the indication for operative treatment became restricted to cases resistant to L-dopa plus a decarboxylase inhibitor or ineffectiveness of such medication on prolonged application.

Parkinson tremor as well as intention tremor could be relieved by lesions of parts of the ventrolateral nuclear complex, particularly the nucleus ventralis oralis posterior. For treatment of the parkinsonian rigidity, the target of choice, besides the pallidum internum, is the ending of the pallidothalamic fibers, the nucleus ventralis oralis anterior.

Two rather similar types of subthalamic lesions were successfully performed: (1) lesion of Forel’s field H (campotomy) in Parkinson’s disease and parkinsonism, athetosis and myoclonia, and (2) lesions of the zona incerta, including the fields H, Hi, and H2, in Parkinson’s disease (particularly in oculogyric crises), in action myoclonus, intention tremor and spasmodic torticollis.

(13) The initial enthusiasm for dentatotomy in spasticity has been replaced by the experience that the reduction of the muscular hypertonus becomes less marked after several years. Thus, the necessity of sequential, multiple lesions in spasticity of cerebral palsy became recognized, e.g., the combination of lesions of the contralateral zona incerta, of the ventrooral, the ventral intermedius and ventral posterior nuclei, of the pulvinar and eventually of the homolateral dentate nucleus.

(14) In spasmodic torticollis central lesions were performed contralateral to the hyperactivity of deep neck muscles, recognizable by electromyography, mostly, but not always, homolateral to the hypertrophic sternocleidomastoideus muscle. The lesions involved, e.g., the nucleus ventralis oralis internus and Forel’s field H or the nucleus ventralis oralis internus and the pallidum. Such procedures may prove insufficient, so that peripheral lesions have to be added, e.g., interruption of spinal accessory fibers to the hypertrophied sternocleidomastoideus muscle and eventually bilateral section of the anterior rami of Q-C3, and possibly C4 unilaterally, innervating the hyperactive deep neck muscles.

(15) In chronic pain, favorable results were experienced on intermittent transdermal stimulation of peripheral nerves, on application of stimuli at relatively high frequencies (30-200 Hz) to the posterior columns, to the area of the mesencephalic medial lemniscus, to the ventral posterior and some other thalamic nuclei, to the periaqueductal or periventricular gray,
and to the posterior limb of the internal capsule.

(16) Therapeutic success was reported also on stimulation of the posterior columns in spasticity, of the ventral posterior thalamic nuclei in dyskinesias, and of the posterior columns or of the ventrooral thalamic nuclei and of the zona incerta in spasmodic torticollis. These observations justify further studies. Chronic cerebellar stimulation hardly can be recommended in view of the undesirable side effects.

(17) Obliteration of the lumen of intracranial aneurysms, angiommas, arteriovenous malformations, chiefly by production of a local thrombosis.

(18) Evacuation of intracerebral hematomas, aspiration of intracerebral abscesses.

(19) Removal of foreign bodies.

(20) Implantation of radioactive isotopes in deep-seated cerebral tumors, or their elimination by laser beams.

(21) Hypophysectomy in pituitary tumors; for inhibition of tumor growth and pain relief in metastasizing, sex-linked tumors; in diabetic retinopathy.

(22) There is now a close cooperation in many institutions between the stereotactic neurosurgeon, the roentgenologist and the computer specialist. This promises further to refine the technique of guided brain operations and to minimize unnecessary damage to the patient’s brain.